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United States Department of Agriculture,

OFFICE OF EXPERIMENT STATIONS—CIRCULAR 88 (Revised).

A. C. TRUE, Director.

ORGANIZATION, WORK, AND PUBLICATIONS OF DRAINAGE INVESTIGATIONS.

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ENGINEERS AVAILABLE FOR SPECIAL WORK.

A. E. MORGAN, S. M. WOODWARD, J. T. STEWART.

SCOPE OF WORK.

The work of Drainage Investigations in the Department of Agriculture has been continued since its inception in 1902, and is now being carried on under authority of an act making a definite appropriation for conducting such investigations by the Office of Experiment Stations.

The field of investigations has rapidly extended from the beginning, until at the present time it covers portions of thirty States in all sections of the country. The general scope of the work embraces the investigations of the best practical methods—

(1) Of removing surplus water from lands which have an agricultural value;

(2) Of protecting fertile lands from the periodical overflow of streams;

(3) Of reclaiming tidal lands which are susceptible of profitable cultivation;

(4) Of controlling and conserving the rainfall on tillable hillside lands.

In pursuance of these ends the work is carried on along the following lines:

First. The study of drainage literature and the dissemination of the valuable knowledge thus obtained, which includes—

(a) Methods of drainage, past and present, both at home and abroad, whether successful or otherwise, that the solution of drainage problems constantly arising in connection with the advance in agriculture may be facilitated;

(b) Drainage laws in force in this country, with a view of bringing them up to the highest possible point of efficiency, and also to make them clearly understood by all concerned;

(c) Drainage laws of other countries and the possible adaptation of their good points to meet the requirements of the United States;

(d) The collection and systematic arrangement of the principles and best methods of practice in drainage and the wide dissemination of such knowledge for the information and stimulation of all who should be interested in this subject.

Second. The rendering of practical assistance in the initiation of drainage improvements in representative localities along the following lines:

(a) Written and verbal reports upon the feasibility of proposed drainage propositions based on preliminary examinations;

(b) Definite plans for drainage based upon complete surveys made entirely by the Office or in cooperation with local organizations;

(c) Surveys, plans, and supervision of experimental drainage work in cooperation with individuals or communities undertaken with a view of determining methods of draining which will apply to special localities.

Third. The solution of special problems in drainage presented in the various parts of the country. Among these are—

(a) Irrigated lands injured by seepage water;

(b) Lands subject to periodical overflow;

(c) Swamp lands;

(d) Salt marsh lands;

(e) Muck and peat lands;

(f) Hillside farm lands;

(g) Farm lands which have failed to be benefited by ordinary methods of drainage.

Fourth. Original experimental research to secure data of value to engineers and others in making plans and estimates, including such problems as—

- (a) The maximum discharge of water, or run-off, from drained watersheds of different areas;
- (b) The fluctuation curve of the water table in drained fields;
- (c) Changes in the physical structure of subsoil clays resulting from their drainage;
- (d) Movement and behavior of soil water in irrigated land;
- (e) The laws governing erosion and sedimentation of ditches;
- (f) The coefficient of flow in small drainage channels at flood height;
- (g) The effect of the removal of bends upon the carrying capacity of a drainage channel;
- (h) The study of flood conditions to determine proper levee heights;
- (i) Tests of cement drain tile.

Knowledge obtained along the foregoing lines is disseminated by means of printed bulletins and reports, personal consultation and correspondence, public addresses, and plans and manuscript reports prepared for special localities.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS RELATING TO DRAINAGE.

[Corrected to January 25, 1910.]

PUBLICATIONS FOR RESTRICTED DISTRIBUTION.

These bulletins are furnished free, so long as they are available, to libraries, educational institutions, the press, State and foreign officials connected with agriculture, exchanges, and such persons as are in active cooperation with the Department or render tangible service in its work. Other persons can obtain them from the *Superintendent of Documents, Government Printing Office, Washington, D. C.*, by payment of the price given; postage stamps and personal checks are not accepted.

Bulletin No. 147.—Report on Drainage Investigations in 1903. By C. G. Elliott. Pp. 62, pls. 6, figs. 12. Price 10 cents.

Includes discussion of plans for drainage near Fresno, Cal.; in the Yakima and Atanum valleys, Washington; in the Grey Bull Valley, Wyoming; in the Missouri Valley; in Hancock County, Iowa; of hillside lands subject to erosion in Georgia.

Bulletin No. 189.—Report on the Drainage of the Eastern Parts of Cass, Traill, Grand Forks, Walsh, and Pembina Counties, North Dakota. By John T. Stewart. Pp. 71, pls. 6, figs. 2. Price 25 cents.

Discusses general topographic and climatic conditions of the region under consideration as related to drainage; size and form of ditches required; erosion and silting

of ditches; effect of straightening natural drainage channels; method of making surveys; estimates of quantities and cost of excavation; detailed estimates for each county accompanied by maps showing location of all the proposed ditches.

Bulletin No. 198.—The Prevention of Injury by Floods in the Neosho Valley, Kansas. By J. O. Wright. Pp. 44, pls. 14, figs. 3. Price 20 cents.

Describes the present condition of the valley and river channel, and the attempts which have been made to secure protection from injury; explains in detail a plan for protecting from injury the overflowed lands by means of levees, based on a comprehensive survey of the valley; gives specifications for building the levees, and estimates their cost.

Bulletin No. 217.—The Drainage of Irrigated Lands in the San Joaquin Valley, California. By Samuel Fortier and V. M. Cone. Pp. 58, pls. 2, figs. 9. Price 15 cents.

Contains results of experiments in draining irrigated lands at Fresno and in the Modesto and Turlock irrigation districts in California, for the removal of alkali and for holding the ground water below the root zone of plants.

PUBLICATIONS FOR FREE DISTRIBUTION.

[These publications may be obtained by addressing the Secretary of Agriculture, Washington, D. C.]

Farmers' Bulletin No. 187.—Drainage of Farm Lands. By C. G. Elliott. Pp. 38, figs. 19.

Explains the effects and advantages of drainage; describes the construction, cost, and behavior of open drains; discusses tile drainage in full, including location, depth, frequency and size of drains, details of their construction, accessories, cost and profit; treats of the drainage of irrigated land.

Farmers' Bulletin No. 371.—Drainage of Irrigated Lands. By C. F. Brown. Pp. 52, figs. 19.

Describes many experiments to determine best methods of reclaiming irrigated lands which have been injured by seepage or by the rise of alkali, or by both combined. Draws deductions from these experiments and describes methods of draining various classes of irrigated lands.

Circular No. 74.—Excavating Machinery Used for Digging Ditches and Building Levees. By J. O. Wright. Pp. 40, figs. 16.

Describes the use and construction of different classes of dredges, including dipper, clamshell, rotary, roller, scraper, elevator, and hydraulic dredges, and drag boats; first cost and cost of operation of dredges; machines for levee building; machine for ditching.

Circular No. 80.—A Report upon the Drainage of Agricultural Lands in the Kankakee River Valley, Indiana. By C. G. Elliott. Pp. 23, figs. 3.

Prepared from investigations and surveys conducted by W. D. Pence, Morton H. Downey, et al. Gives plans and specifications and estimates of cost for the improvement of the lower section of the Kankakee River Valley; describes valley and methods used in draining its lands, also discusses the Yellow River problem.

Circular No. 86.—Preliminary Report on the St. Francis Valley Drainage Project in Northeastern Arkansas. By A. E. Morgan. Pp. 31, figs. 3.

Presents a preliminary plan of drainage for an area of about 1,000,000 acres in Mississippi, Craighead, and Poinsett counties, based on careful surveys made by Drainage Investigations. Deals with methods of construction and estimate of cost, sizes of channels, special problems, existing ditches, etc.

Circular No. 88, revised.—Organization, Work, and Publications of Drainage Investigations. Pp. 6.

Separate No. 9, Bulletin No. 158.—Report of Drainage Investigations, 1904. By C. G. Elliott. Pp. 643–743, pls. 4, figs. 52.

Discusses ground water records; drainage in Utah; cleaning dredged drainage ditches; construction and maintenance of large ditches through sandy lands; plans for the drainage of the bottom lands of the Missouri River in South Dakota; reclamation of overflowed lands, including locations on the Illinois, Wabash, and Mississippi rivers; levee construction and maintenance; Florida Everglades; Wisconsin marsh lands; drainage of hillside farm lands; Indiana tile drainage.

Document No. 1028.—Reclamation of Tide Lands. By J. O. Wright. Pp. 373–397, pls. 5, figs. 6. (Reprint from Annual Report of the Office of Experiment Stations for 1906.)

Discusses beneficial results obtained from the reclamation of tide lands both in this country and in Europe; best methods of reclamation; suitable location, shape, and size of dikes or embankments; machinery fitted for doing the work; wave protection; tide gates; internal drainage and supplementary pumping plant; specifications for building embankments and sluice gates.

Document No. 1136.—Progress in Drainage. By C. G. Elliott. Pp. 387–404, figs. 8. (Reprint from Annual Report of the Office of Experiment Stations for 1907.)

Discusses the water of the soil; drainage outlets; relation of public and private drainage; State general drainage laws and difficulties in carrying them out; the methods and mistakes of drainage; the field and character of work for Drainage Investigations.

Document No. 1144.—Drainage Investigations, 1907–8. By C. G. Elliott. Pp. 38–44, fig. 1. (Reprint from Annual Report of the Office of Experiment Stations for 1907.)

A general discussion of the field of work of Drainage Investigations.

Document No. 1222.—The Alluvial Lands of the Lower Mississippi Valley and their Drainage. By A. E. Morgan. Pp. 407–417, pls. 2, figs. 2. (Reprint from Annual Report of the Office of Experiment Stations for 1908.)

Discusses the extent and formation of these lands and the characteristics of the soil and vegetation and calls attention to the necessity of comprehensive drainage surveys and drainage works.

PUBLICATIONS OUT OF PRINT.

The supply of the following publications is exhausted and hence they are no longer available for distribution:

Circular No. 50.—Preliminary Plans and Estimates for Drainage of Fresno District, California. By C. G. Elliott. Pp. 9, pls. 2.

Circular No. 57.—Supplemental Report on Drainage in the Fresno District, California. By C. G. Elliott. Pp. 5.

Circular No. 76.—The Swamp and Overflowed Lands of the United States. By J. O. Wright. Pp. 23, pl. 1.

Gives an estimate of the area of swamp lands in the different States, its ownership, present value, cost of reclamation, and probable value when reclaimed, and discusses the State laws relating to drainage.

Circular No. 81.—A Report upon the Drainage of the Agricultural Lands of Bolivar County, Mississippi. By W. J. McEathron and S. H. McCrory. Pp. 28, fig. 1.

Describes the physical conditions of the district which is situated in Bolivar County, Miss., in the Yazoo Delta, and outlines a plan of drainage for the entire section and gives an estimate of the cost of the work recommended.

Document No. 799.—Report of Irrigation and Drainage Investigations, 1904. By Elwood Mead, Chief. Pp. 425–472, pls. 5, figs. 5. (Reprint from Annual Report of the Office of Experiment Stations for 1904.)

Discusses scope of the year's work; ground water fluctuations at Fresno, Cal.; experimental drainage of irrigated land in Utah; protection by means of levees of overflowed bottom lands in the humid region; levee construction; machinery for laying tile drains.

Document No. 925.—Drainage Investigations. By C. G. Elliott. Pp. 197–210. (Reprint from Annual Report of Office of Experiment Stations for 1905.)

A general discussion of the field of work of Drainage Investigations.

Separate No. 265.—Some Engineering Features of Drainage. By C. G. Elliott. Pp. 231–244, pl. 1, figs. 2. (Reprint from Yearbook, 1902.)

A brief discussion of some general features of drainage and a description of some drainage works near Greeley, Colo.

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